



U.S. Army Research, Development and Engineering Command



***TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.***

System Engineering Applied to Decision Making  
27 October 2011

Mr. Randall Safier  
with Mr. Andrew Yee / Ms. Rebecca Addis / Mr. Si Dok

UNCLASSIFIED: Distribution Statement A. Approved for public release.

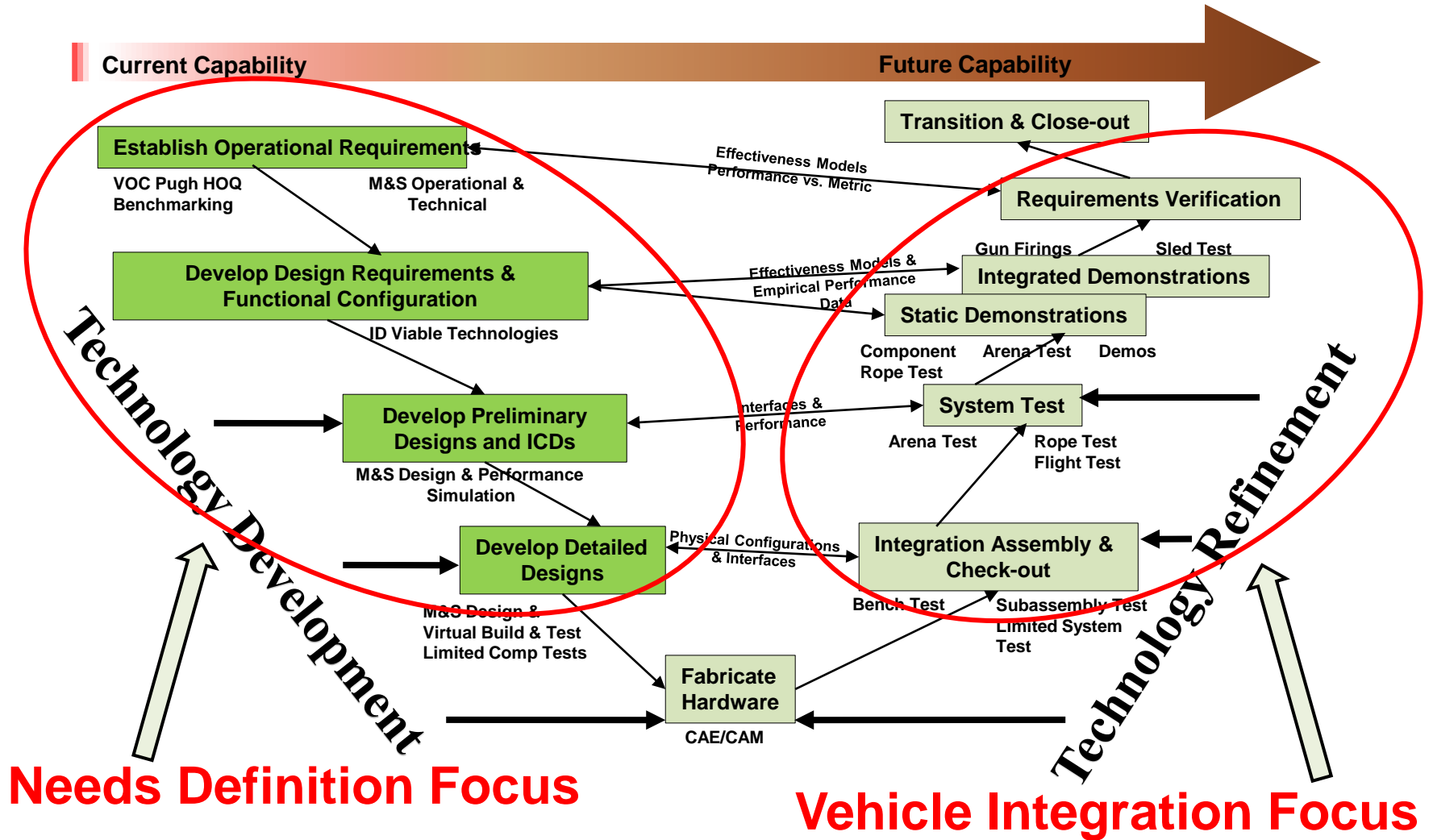
Report Documentation Page			Form Approved OMB No. 0704-0188		
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE <b>27 OCT 2011</b>		2. REPORT TYPE <b>N/A</b>		3. DATES COVERED <b>-</b>	
4. TITLE AND SUBTITLE <b>System Engineering Applied to Decision Making</b>			5a. CONTRACT NUMBER		
			5b. GRANT NUMBER		
			5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S) <b>Randall Safier; Andrew Yee; Rececca Addis; Si Dok</b>			5d. PROJECT NUMBER		
			5e. TASK NUMBER		
			5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>US Army RDECOM-TARDEC 6501 E 11 Mile Rd Warren, MI 48397-5000, USA</b>			8. PERFORMING ORGANIZATION REPORT NUMBER <b>22372</b>		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) <b>US Army RDECOM-TARDEC 6501 E 11 Mile Rd Warren, MI 48397-5000, USA</b>			10. SPONSOR/MONITOR'S ACRONYM(S) <b>TACOM/TARDEC/RDECOM</b>		
			11. SPONSOR/MONITOR'S REPORT NUMBER(S) <b>22372</b>		
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release, distribution unlimited</b>					
13. SUPPLEMENTARY NOTES <b>The original document contains color images.</b>					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>UU</b>	18. NUMBER OF PAGES <b>14</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

UNCLASSIFIED

- Warfighter Needs Must Still Be Met Despite Common Expectation Of Declining Resources
- Challenge To Maximize The Value Of Defense Science And Technology Efforts Requires Their Relevance To The Acquisition Community Mission
- Systems Engineering Techniques Can Be Leveraged As An Effective Tool To Assist In Making Difficult Decisions
- Two (2) TARDEC Systems Engineering Group Support Efforts Are Summarized As Examples Of The Above

UNCLASSIFIED

UNCLASSIFIED



UNCLASSIFIED

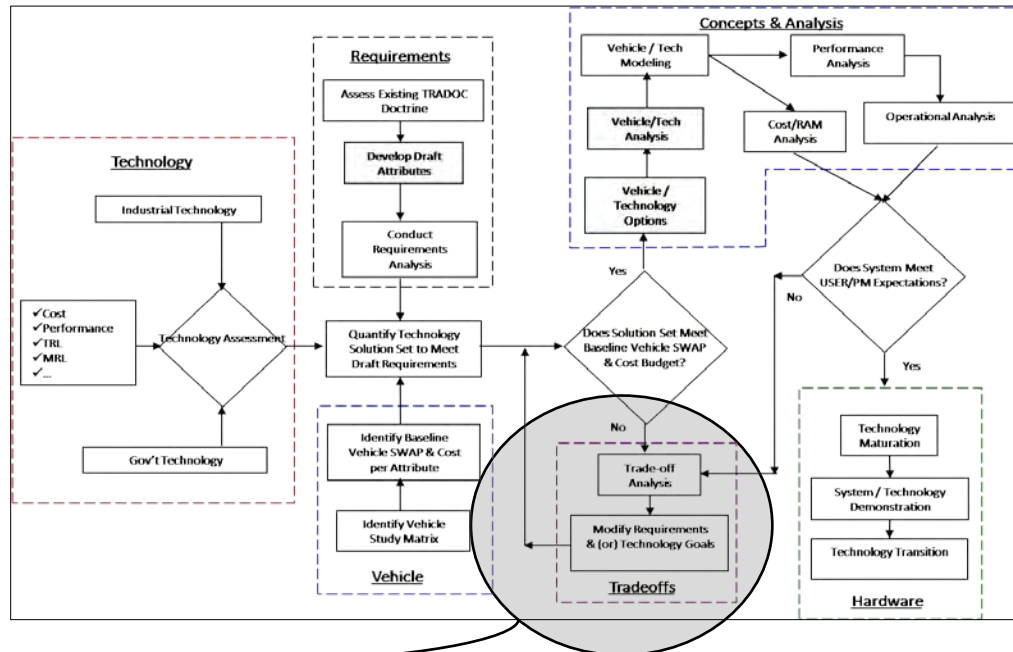
UNCLASSIFIED

- Task 1 (May-Oct 10): Using A Specific Vehicle And Mission Set, Develop A Repeatable Process And Necessary Toolset To Analyze The Benefits Of Capability Package Proposed Technologies And Evaluate Tradeoffs Between Performance And Constraints
  - Overall Effect On System Performance
  - Ability To Close Capability Gaps And Meet User Requirements
  - Applied to Capability Package (CP) 11-12
- Task 2 (Nov 10 – Present): Assist the TARDEC Ground Domain Planning and Integration (GDP&I) Team in Technology Needs Analysis To Guide Decisions on S&T Programs

UNCLASSIFIED

UNCLASSIFIED

## TARDEC Ground Vehicle Technology Integration and Assessment Process

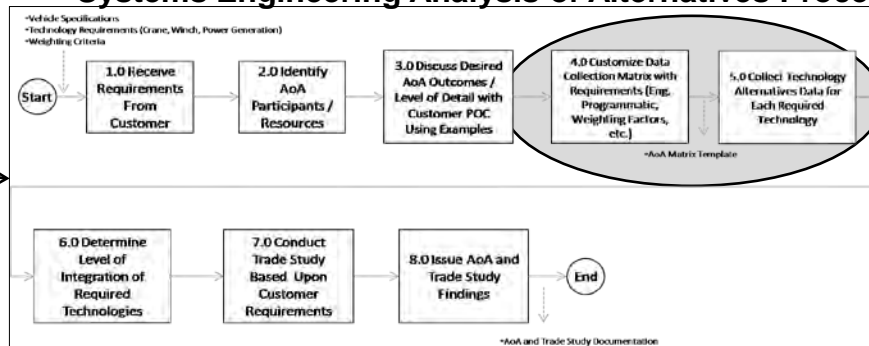


### Example Trade Study Criteria Matrix

Criteria	Weighting	Scoring Rationale		
		3 Low	6 Med	9 High
<b>Engineering</b>	15	Hard-requires significant modification of sub-systems	Complex - Impacts multiple sub-systems	Easy - Stand-alone (Bolt-on)
Burdens (SWAPC)				
Ease of Integration				
Testing Required? (schedule to field)				
<b>Production</b>	11	9 months from time of award	6 months from time of award	<3 months from time of award
MRL -Material Availability				
Ease of Production Cut-In				
<b>User Priority</b>	19	Nice to have	Mission Essential	Mission Critical
User(s) Priority				
Safety				
<b>Logistics</b>	14	Significant Impact	Impact	Minimal Impact
Ease of Retrofit				
Life Cycle Cost				
Field implemented Fixes				
Logistic Footprint				
O&S (log)				
<b>Cost</b>	8	> 20% of total vehicle cost	5 % - 20% of total vehicle cost	< 5% of total vehicle cost
Technology Cost				
Life Cycle Cost				
O&S (log)				
<b>Schedule</b>	18	Fielded in > 180 days	Fielded 61-180 days	Fielded in < 60 days
Schedule to Field				
Field Implemented Fixes				
<b>Performance</b>	15	Increase with significant negative impact on other areas	Increase with minimal negative impact in other areas	Significant increase w/o negative impact on other areas
System Effectiveness				
Threshold Threats				
Objective Threats				
Mobility Effectiveness				
RAM				
Employment				

100

### Systems Engineering Analysis of Alternatives Process



UNCLASSIFIED

UNCLASSIFIED

- Objective:
    - Maximize performance based on weighted parameters
  - Subject To:
    - *Burdens*
    - *Cost*
    - *Risk*
    - *Growth Potential*
  - Target Result:
    - Best suite of technologies for the CP11-12 host vehicle
- Optimization Goal
- Constraints

UNCLASSIFIED

UNCLASSIFIED

- Better Strategy Required For Gathering Data Across Multiple Organizations (e.g. multiple Program Executive Offices (PEOs) and Program Managers (PMs)); Data Gaps Necessitated Use Of Notional Data For Demonstration Purposes
- The Trade Study Team Needs To Be A Central Part Of Integration Team And Drive The Data Gathering Activities And Analysis
- The Trade Study Should Also Be A Part Of Interim Reviews For All Subject Matter Experts (SMEs)

UNCLASSIFIED



## UNCLASSIFIED

- Streamline The Process For Collecting Needs Data (Eliminate Re-invention Of New Lists Each Year)
- Contribute To Driving Out Requirements By Decomposing Needs To Enable Appropriate Action
- Assist In Obtaining Metrics Data To Evaluate How Well Programs Meet Needs By Working With SMEs & PM Partners
- Propose Needs Commonality Across PM Platforms
- Facilitate Needs Alignment With Programs
- Provide A Template/Spreadsheet For Needs Data
- Configuration Control Of The Needs Within The Database (Traceability)
- Provide Traceability Of Needs To TARDEC Programs And PEO/PM Capability Gaps IAW Priorities & Budget
- Generate Reports To Support Program Decisions

## UNCLASSIFIED

UNCLASSIFIED

## TARDEC SEG Focus

- Project Execution Management**
- TARDEC Evaluation
  - Project Management Best Practice Standardization
  - Earn Value Management Training
  - Project Governance
  - Project Health Dashboard



- Assess Balance and Alignment to Strategy
- Refine Recommended Strategy

**Balance Portfolio to align with Ground Domain Priorities**

**Portfolio Assessment**

- Portfolio Assessment**
- Analyze portfolio balance and alignment for leadership and tech developers.
  - Monitor portfolio health and assess impacts from changes.

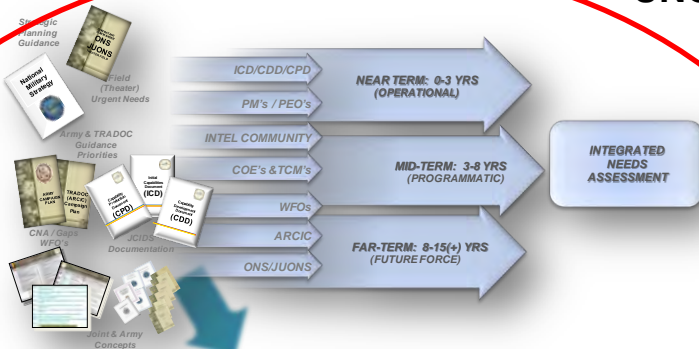
**Align Investments to Meet Ground Domain Priorities:**

- Combat Vehicles
- Tactical Vehicles
- Robotics
- Base Camps

### Strategic Project Planning

- Coordinate Tech Gaps
- Align Acquisition/ST&T Plans and Schedules
- Develop Ground Strategic Technology Plans & Roadmaps
- Annual POM Planning
- Annual Guidance

UNCLASSIFIED



### Strategic Needs Analysis

- Gather, Analyze, Integrate Needs
- Identify and Prioritize Ground Domain Gaps aligned to Strategic Vectors and time-phased needs.

**Identify and Prioritize Gaps**



UNCLASSIFIED



NEAR TERM: 0-3 YRS  
(OPERATIONAL)

MID-TERM: 3-8 YRS  
(PROGRAMMATIC)

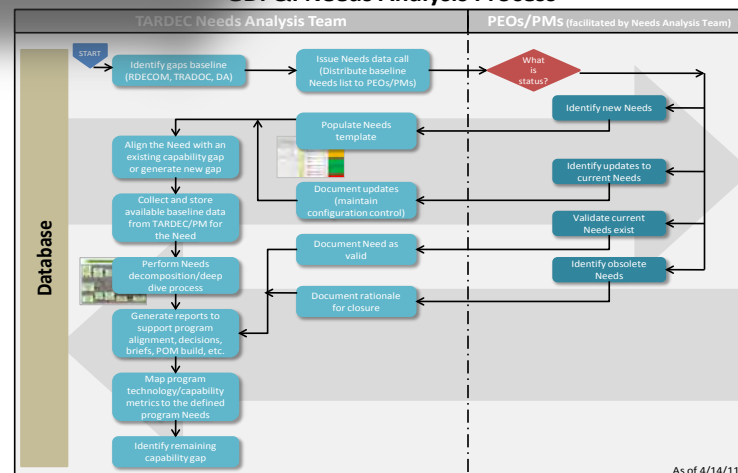
FAR-TERM: 8-15(+) YRS  
(FUTURE FORCE)

INTEGRATED  
NEEDS  
ASSESSMENT

## Integrated Needs Analysis

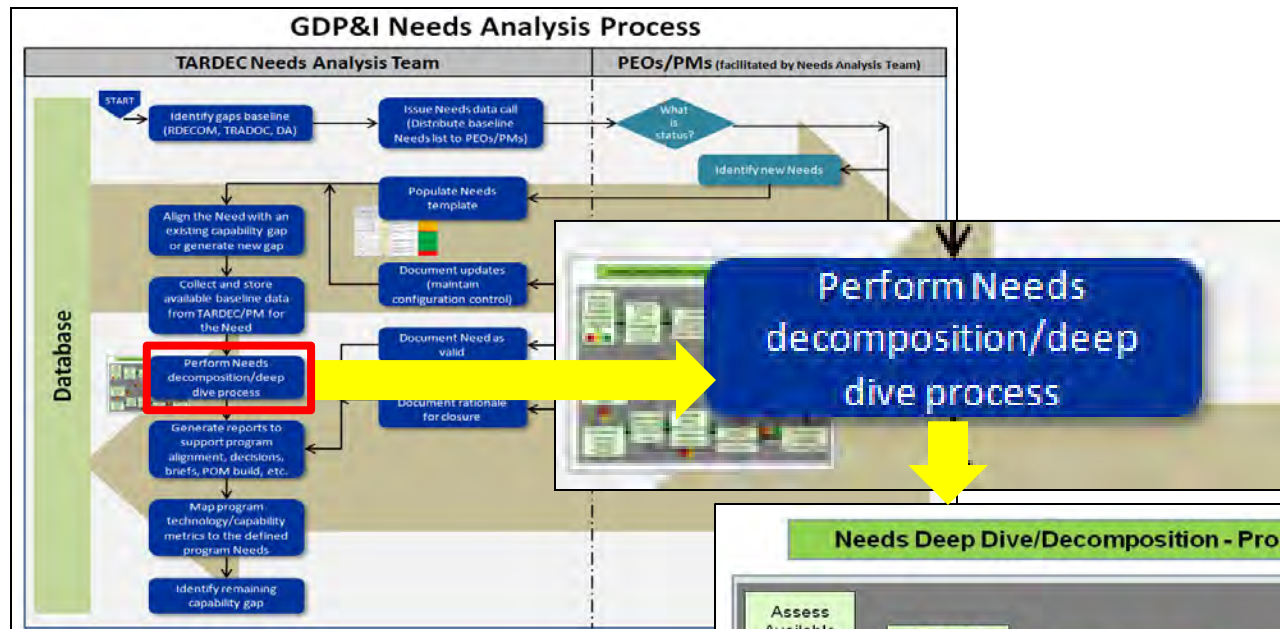
- Gather, Analyze, Integrate Needs
- Identify and Prioritize Ground Domain Gaps aligned to Strategic Vectors and time-phased needs.

## GDP&I Needs Analysis Process



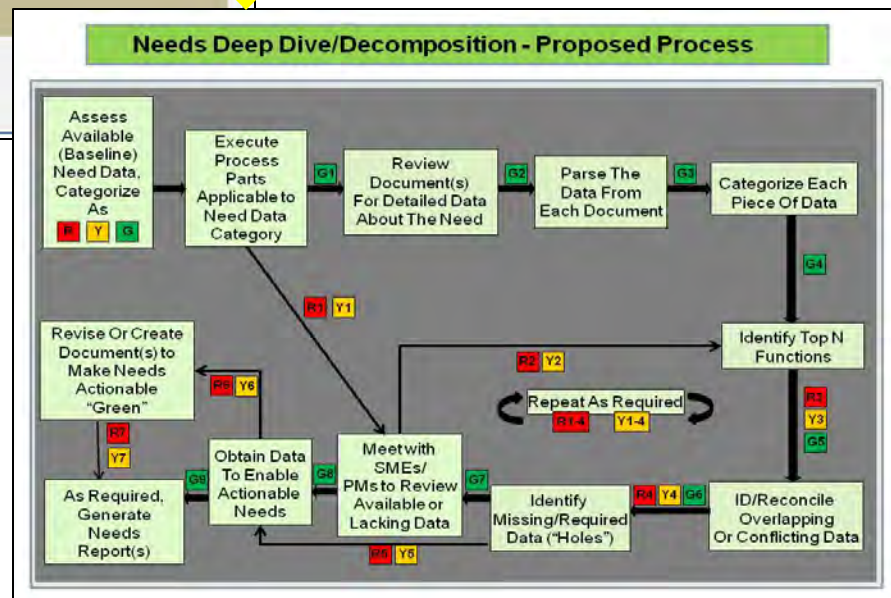
UNCLASSIFIED

UNCLASSIFIED



## Decompose Needs into Requirements

- Identify and document Functions, Performance, Constraints, Interfaces
- Verify with product and tech area SMEs

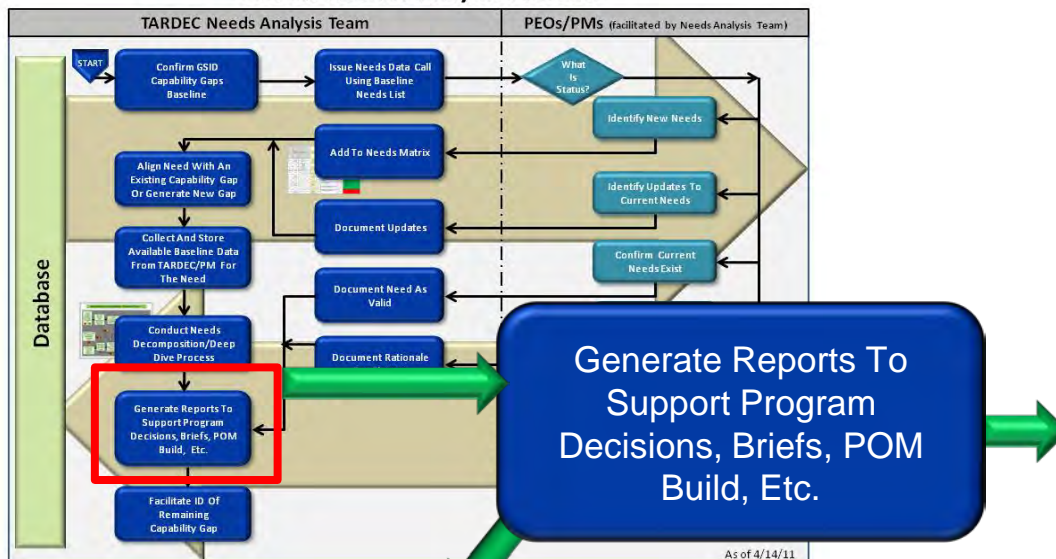


UNCLASSIFIED



**UNCLASSIFIED**

## GDP&I Needs Analysis Process



## DOORS Export to Excel

[illegible]

## Generate Reports

- Needs list (timeframes, commonality, etc.)
- Needs trace to gaps, programs, WFOs
- Required capability metrics vs. current capability metrics

## DOORS Database

**UNCLASSIFIED**

UNCLASSIFIED

- Systematic Needs Analysis Aids Alignment of Warfighter (Customer) Requirements to R&D/S&T Portfolio
- Needs Analysis Conducted Across Multiple PEO/PM Communities Can Identify Common Programs To Deliver Most “Bang for the Buck”
- Long Term Technology Development Might Not Match PM time frame of interest, normally focused to the POM Cycle

UNCLASSIFIED

UNCLASSIFIED

- Warfighter Needs Must Still Be Met Despite Common Expectation Of Declining Resources
- Challenge Is To Maximize The Value Of Defense Science And Technology Efforts To Ensure Their Relevance To The Acquisition Community Mission
- Systems Engineering Techniques Can Be Leveraged As An Effective Tool To Assist In Making Difficult Decisions

## *Questions?*

UNCLASSIFIED